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PROBLEMS OF WATER RESOURCES MANAGEMENT WITH THE HELP OF INFORMATION-MODELING COMPLEXES

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Abstract: *The article considers the natural conditions of the Tupolon river basin. The main modern characteristics of the water bodies of the basin (hydrological, hydrochemical, hydrobiological) are given, the factors and intensity of self-purification of water bodies, water management activities and anthropogenic load are studied. A comprehensive assessment of the water resource potential and the ecological state of the waters in the basin was carried out. The problems of water resources management in the river basin are highlighted, recommendations are given for improving the management of its water management complex. The main parameters of information modeling complexes and decision support systems for the problems of integrated water resources management Tupolon are given.*
Key words: *natural system, hydrospheres, hydrological situations, low water, radiochemical.*

Introduction

The Tupolon River is a complex natural system with a wide range of zonal features on the plain and altitudinal zonality in the mountains. The multifactorial nature of the formation of the conditions of the Tupolon River determines the specifics of the functioning of its hydrosphere and influences the state of the water resource potential. In particular, a significant submeridional length of the river and the resulting natural conditions have led to the presence of certain extreme hydrological situations, which, first of all, include floods and floods, as well as low water, creating extremely unfavorable and emergency conditions for water use in the regions.

The long-term operation of the largest radiochemical, coal mining, metallurgical, petrochemical, oil and gas production facilities in the Tupolon River in Uzbekistan has led to radioactive, chemical and biological pollution of water and bottom sediments of rivers, lakes, swamps and artificial reservoirs, underground horizons. Water quality problems are more typical for large industrial centers, the water supply of which is mainly carried out at the expense of surface water sources.

Studies of the current state of water bodies, scientific substantiation of methods and means to ensure the sustainable functioning of the water management complex in the Tupolon River.

The relevance of such studies is confirmed by the need to develop a unified conceptual model of sustainable water use in the regions of Surkhandarya, which should take into account the differentiation of these territories in the natural, environmental and socio-economic contexts, significant changes in the existing imbalances in the water management complex and meet modern requirements for the modernization of society and the development strategy of its regions.

Therefore, the solution of the following tasks: adjustment of the quantitative and qualitative assessment of surface and groundwater resources; comprehensive assessment of the ecological

state of the Tupolon water body of the basin system, development of information-modeling complexes and decision support systems (DSS) for the tasks of integrated water resources management; formation of the concept of the sustainable water use program; assessment of dangerous and unfavorable hydrological phenomena (negative impact of water), risks of emergency situations.

In this regard, it is necessary to study the following tasks:

- assessment of the current state of morphometry of water bodies;
- extension of long-term runoff series with the restoration of monthly runoff values;
- analysis of the hydrometeorological knowledge of the basin and a comparative assessment of the results obtained with the existing requirements for the organization of the monitoring system;
- assessment of the state of water bodies in terms of hydrochemical and hydrobiological indicators;
- assessment of the impact of concentrated and diffuse sources of pollution on the state of ground and surface waters;
- assessment and forecast of anthropogenic load on the watershed;
- forecast of changes in the water content of rivers in the main sections of the basin;
- determination of zones of flooding of the territory during high waters and floods of various security;
- development of database structures for water bodies of the basin in accordance with the formats of the State Water Register and monitoring of water bodies;
- assessment of the provision of the population with high-quality drinking water;
- assessment of the impact of transboundary pollution transfer on the ecological state of water bodies, factors and intensity of self-purification, risks of water use and forecast of hydroecological safety, taking into account the international aspect;
- assessment of the conditions and consequences of intra-basin and inter-basin redistribution of water flow;
- development of information modeling complexes for use in the DSS for the management of specific aquatic ecosystems in the Tupolon River;
- development of recommendations for improving the monitoring system of water bodies.

The problem is the study of the process of formation of the quantity and quality of surface and groundwater and the factors that determine them: hydrological, hydrochemical, hydrobiological, biogeochemical, landscape-ecological.

The purpose of the work is to obtain new data on the current state of water bodies and their catchment areas and objects of the Tupolon basin and the conditions for their intended use.

The research is based on mathematical modeling of representative water bodies to predict water quality, extreme hydrological phenomena on the rivers of the basin and other tasks.

The study of the Tuaoln reservoir as a model object in these works made it possible to give a modern description of the reservoir, including the state of its banks, as well as individual components of its ecosystem.

Therefore, it is predicted that the banks of the reservoir will be reworked for the next decade, and recommendations will be developed on the mode of use of the water protection zone. A methodical and algorithmic basis for solving a number of problems relevant for the operation of the reservoir is being prepared: calculation of the passage of a spring flood wave through the Tupolon reservoir and its downstream, taking into account control actions; development of recommendations on the use of the reservoir during the winter low water period, development of a simulation model for the functioning of the reservoir.

The soil and vegetation cover of the basin has a pronounced zonality of distribution in accordance with natural and climatic zones and altitudinal zonality.

Zonal and azonal factors of the natural environment, which form the basis of the physical and geographical zoning of the territory, determine the regional differentiation of the conditions for the formation of runoff, affecting both the climatic and orographically determined (at the level of zonal and mountainous regions) the incoming component of the water circulation balance, and the outgoing component in terms of evaporation (heat supply) and redistribution between surface and underground runoff (relief, lithology of rocks in the aeration zone, and so on).

The set of factors that determine the conditions and processes of formation of surface and groundwater is represented by three groups: climatogenic (water-heat balance), landscapeogenic (landscape components characterizing the underlying surface) and anthropogenic (economic activity affecting the structure of the water balance).

The volume of runoff is determined by the amount of precipitation received, the consumption for evaporation and the features of the underlying surface, which regulate the redistribution of runoff between the surface and underground components and the rate of runoff of the precipitated moisture. The zonality of the water balance is most clearly manifested in the characteristics of its structure. (E, $U=f(W)$).

Relationships between the three elements of the water balance (E - total evaporation, U - underground components of the river runoff and W - gross moistening of the territory) became the basis for identifying the types of water balance on the territory of the Surkhandarya Plain and assessing the sources of water resources - river, underground, soil moisture in their relationship.

As a result of the studies, the dependence of the annual values of the underground component of the annual runoff (base layer, Y_{min}, mm) to its total annual volume {Y_{year}, mm) due to changes in the size of the catchment area (F, thousand km^2).

The resulting graphs show that the relationships between Y_{min}/Y_{year} and the area of the river basin in the region are not unambiguous, which confirms, first of all, the deep differences in the drainage of underground runoff in different natural and climatic conditions of the Tupolon basin.

The dependence of the runoff coefficient on the moisture content of the river basin, compiled according to the actual data, indicates that with an increase in moisture content, the values of the runoff coefficients naturally increase.

In the river basins of the zone of excessive moisture, at least 36% of the moisture resources are spent on the formation of river runoff, in the zone of insufficient moisture - no more than 10%.

For large rivers in the basin, the flow of the limiting period (July-March) is from 23 to 32% of the

annual, the limiting winter season is from 6 to 12%. Small and medium rivers are characterized by extremely low (up to 1%) winter runoff or its absence.

Water quality is related to the geological structure of the catchment area, the natural geochemical specialization of the territory, the chemical composition and leaching activity of atmospheric precipitation. The volume and quality of waters depend on the anthropogenic load, which has direct, indirect and indirect effects on these characteristics.

The analysis of runoff formation factors was the basis for a comprehensive assessment of the state of water bodies.

To perform hydrological calculations and forecasts for liquid runoff, a list of studied watersheds in the Tupolon river basins was determined, representative sections (long-row stations) were selected to extend long-term runoff series (until 2018) and hydrological calculations for liquid runoff. Hydrological cross-sections are selected taking into account the relationship of the annual runoff.

Information on hydrometeorology and environmental monitoring has been collected on the basis of hydrological handbooks and yearbooks. The calculations were made in accordance with the "Manual for determining the calculated hydrological characteristics" using original software that has a state registration certificate.

To quantify the water resources of the river itself. Tupolon used data from the State Water Cadastre.

The points with the longest observation period, which characterize the change in water content along the length of the river, were chosen as the gauges by which the resources of surface waters were determined. Tupolon.

According to the nature of the intra-annual distribution of runoff, the rivers belong to the type of rivers with pronounced spring floods, rain floods in the warm part of the year, and relatively low low-water flows in winter and summer periods.

The minimum water discharges are observed at the end of the periods of summer (September-October) and winter (February-March) low water periods. On all rivers with a natural runoff regime, the winter minimum discharges are 1.5-3 times less than the summer-autumn ones.

The reserve of groundwater use for domestic and drinking water supply and irrigation is significant.

It should be noted that in the western part of the Surkhandarya region there is a shortage of underground flow, due to the geological structure and features of hydrogeological conditions.

Reserves for the use of groundwater in the central part of the basin are huge. In most cases, these waters, due to the specific natural conditions of formation, do not meet the established quality standards for the content of iron, manganese, in the northern regions - silicon, as well as for the value of permanganate oxidizability. With this in mind, in most of the territory, aquifers can be attributed to the second and third classes of water supply sources.

Therefore, there is a place of difficulty with the domestic and drinking water supply of a number of new settlements and objects that have arisen recently in connection with the development of this territory.

The following manifestations of the negative impact of water are typical for water bodies in the Tupolon river basins:
- floods (flooding of territories);
- dangerous changes in the level of groundwater: extremely low and extremely high (flooding);
- low water;
- negative channel processes (washing away of banks, erosion of river beds, transfer of solid runoff, interception of channels);
- processing of reservoir banks.

Among the noted unfavorable hydrological situations, the greatest danger is represented by floods, which on the rivers of the Tupolon basin can be caused by spring (spring-summer) floods, rain floods and jamming phenomena. The negative consequences of channel deformation processes are the erosion of the banks in the area of settlements and infrastructure facilities, the drift of water intake structures, the shallowing of navigable areas, the formation of conditions for the formation of congestion, etc.

To identify trends in the dynamics of the main parameters of atmospheric air that affect the hydrological regime of the Tupolon basin, we analyzed the series of long-term observations of temperature and precipitation in its various parts.

The analysis of changes in water content was carried out on the basis of observational data for the entire period of operation of water measuring posts using trends. For the analytical presentation of the scenario forecast based on linear trends, the following initial fact is important: the runoff rate *Qo,* calculated from series of observations *Qi* and the mean value of the series $Q^T o$, given by the found linear trend, practically coincide, i.e.:

$$Q_0 = \frac{\sum_{i=1}^{n} Q_i}{n} \approx Q_0^T = \frac{Q_1^T + Q_n^T}{2}$$

where $Q^T = A \times T(i) + B$ - trend equation for average annual expenses *Qi; i* = [1...n] serial numbers of elements of a series, *i = 1* corresponds to the beginning of the billing period, *i = n* - to the end of the billing period; *Q1* - the first element of the series of average annual expenditures; *Qn* - the last element of the series of average annual expenditures; *T(i)* - increasing sequence of observation years from T(1) to T(n).

Difference between Q_0, and Q^T_0 tenths to hundredths of a percent. This allows, using a linear trend equation, to calculate the predicted runoff rate for the period from the beginning of observations to 2020 and 2030. In the first step, the value of the ordinate of the trend equation is set Q^T for the end of the period under consideration (T = 2020 or T = 2030), then the average value of the series for the entire observation period (until 2020 or 2030) is calculated, which is the forecast value of the runoff norm.

Accounting, analysis and assessment of the current use of water resources within the boundaries of individual Tupolon river basins were carried out on the basis of state statistical observation

data.

Pollution of aquatic ecosystems comes from concentrated and dispersed (diffuse) sources. The chemical composition and amount of wastewater entering the Ob aquatic ecosystems from concentrated sources vary significantly from year to year. In recent years, a general decrease in the volume of effluents containing pollutants should be noted. The amount of pollutants entering water bodies depends on the volume of wastewater, but the nature of this dependence is ambiguous. A direct correlation (r = 0.8-0.9) was found between the volume of wastewater and the amount of oil products, total nitrogen, surfactants, iron, magnesium and antimony discharged into water bodies. At the same time, there is a steady upward trend in the amount of nitrates and nitrites discharged by water users into Tupolon aquatic ecosystems, despite a decrease in the total volume of concentrated effluents.

The main amount of oil products is also discharged by water users confined to the river basin. Tupolon. Concentrated runoff brings into the Tupolon basin annually about 50% of sulfates and chlorides, phosphates and ammonium nitrogen, synthetic surfactants and iron compounds, more than 70% of copper, lead, cadmium, manganese, more than 80% of nickel, aluminum, calcium, more than 90% - chromium, vanadium, magnesium from their total amount discharged by large water users of the Tupolon basin. The concentrated supply of fluorine, boron, and especially silicon is associated to a greater extent with water use in the river basin. Tupolon.

The share of economic sectors in the pollution of Tupolon water ecosystems is different both in terms of the volume of discharged water and the nature of pollution. In terms of volumes of wastewater containing pollutants, the leaders are enterprises involved in the collection and treatment of wastewater, including housing and communal services. The share of this industry is about 60%. In second place is coal mining (more than 8%), followed by the production, transmission and distribution of electricity (7), metallurgical (6) and chemical production (5), mining of metal ores (4), production of machinery and equipment (3%).

The economic activity associated with the collection, treatment and distribution of water surpasses other industries not only in terms of the volume of discharge of polluted wastewater, but also in the amount of discharge of water polluting components. Thus, as a result of this activity, more than 40% of the amount of oil products, sulfates, phenols and copper is discharged into the Tupolon basin; 50% or more - suspended solids, chlorides, ammonium and nitrite nitrogen, iron and nickel compounds. This industry is the main supplier of phosphates, nitrates, surfactants, zinc, aluminum, and manganese. The discharge of chromium, bismuth, antimony, cadmium, fluorine, potassium and silicon compounds is mainly due to the activity of metallurgical production. More than 50% of calcium comes with polluted wastewater from enterprises that mine metal ores. The production, transmission and distribution of electricity is more than 75% related to the discharge of vanadium, magnesium compounds to a greater extent (about 40%) - with the work of the coal mining industry.

To assess the contribution of dispersed pollution sources to the formation of surface water quality in the study area, an analysis of the biogeochemical and landscape-geochemical conditions of the

watersheds was carried out based on the following data: the structure of the soil cover of model areas, the type of landscapes, physical and physicochemical forms of pollutants (iron, copper, lead, sulfates, chlorides, etc.), the composition of soil solutions. The approximate input of macro- and microcomponents from soils into surface waters and the average annual modules of pollutant runoff were calculated on the example of model sites located in different natural and climatic conditions and experiencing different anthropogenic load.

The following dispersed sources of surface water pollution have been identified on the territory of the Tupolon basin: oil and mining enterprises, processing industries, areas of deposits with ore bodies coming to the surface, secondary geochemical anomalies, urban landscapes, agricultural lands, territories contaminated with DDT and its metabolites, as well as areas subject to the influence of rocket and space activities.

The influence of the mining industry on the reservoirs of the Tupolon basin was considered on the basis of the Tajik Aluminum Mining and Processing Plant (AGOK). Abnormally high concentrations of heavy metals were found in the water of the reservoir, geochemically associated with the AGOK settling tank. waters.

The AGMP industrial zone is the main factor influencing the ecological state of the surface waters of the region, which is confirmed by the distribution of heavy metals in the water of the transit river. Tupolon. In the area of the industrial zone, their concentrations in water increase by an average of 3-4 times. Local contamination of soils, plants, components of aquatic ecosystems with DDT and its decay products in the area of Tupolonskoye Lake was revealed.

The amount of pollutants entering surface waters from urban landscapes with surface runoff are organic substances.

As noted above, despite the abundance of water resources throughout the Tupolon basin, they are distributed extremely unevenly. More than 68% of the runoff falls on sparsely populated and unsuitable for agricultural development lands of the middle and lower reaches of the Tupolon, while the agrarian and industrially developed regions of the southern part of the basin lack water resources. Surface and groundwater resources are even more unevenly distributed across the territory of Surkhandarya. Due to the growing water shortage in Central Asia (the need to provide the population with high-quality drinking water, the development of industry, etc.), the increase in the water stress index, however, this should not be done by transferring water through open channels, it is much more efficient to use high-tech methods of transporting water. Drinking water can be bottled and sold, transported in tanks, distilled through pipes. But this requires a deep economic, environmental, social and geopolitical study. The assessment of transboundary pollution within the Tupolon basin was made on the basis of a comparative analysis of pollutant discharges in associated water management areas. The calculation was carried out according to the formula: $Q_{3B}= Q_{в}\hat{}C_{3B}$, where $Q_{зв}$ - pollutant consumption, g/s; $Q_{в}$ - average annual water flow in the observation site, m^3/s; C_{3B} - pollutant concentration in the observation site, g/m^3. The costs of the main hydrochemical indicators in the inlet and outlet sections, the balance of substances for each WHC were also calculated. The longitudinal distribution of mineral ion discharges is characterized by their increase in sections of the Tupolon River, which is associated

with an increase in ion concentrations due to changes in natural and climatic conditions (changes in the composition of rocks, soils, precipitation, temperature, and so on). A positive balance between the inlet and outlet sections for the majority of WCS points to the introduction of mineral ions from the catchment area. Data on the content of biogenic elements in the water management areas of the river basin. Tupolon indicate that in its upper reaches there is no excess of MPCvr for any indicator. The dynamics of the consumption of biogenic elements is characterized by their increase in areas located in the taiga climatic zones and experiencing the anthropogenic impact of large cities and towns. This is especially evident in the case of pollution by oil products, the costs of which in the places of oil production increase by 1.5-2 times. Positive balances of organic matter for most water management areas indicate a significant role of the catchment area in the pollution of surface waters of the river. Tupolon these compounds. River pollution analysis Tupolon with heavy metals made it possible to identify acceptable norms for iron and copper in all sections of the river. Tupolon from source to mouth. The high content of manganese and zinc was noted in the sections of the river. Tupolon in the Surkhandarya region and below. However, the lack of data on heavy metals for a number of WHCs does not allow an objective assessment of the pollution of the river. Tupolon on these parameters. The distribution of iron and manganese consumption when moving from the source to the mouth is characterized by their sharp increase in areas located below the region. Calculation of the balance for some WCS was not possible due to lack of data. An analysis of the available information shows that the maximum amounts of iron and manganese occur in sections of the Tupolona River.

The obtained negative balances are associated either with self-purification processes in these areas, or with incorrect data on the content of heavy metals. Thus, for the transboundary transport of substances (water component) within the Tupolon river basin at the regional level rivers from south to north. A decrease in pH and dissolved oxygen, a significant increase in color and concentrations of iron, manganese, nutrients (ammonium nitrogen and phosphates) and organic substances - all these are the consequences of the drainage of vast wetlands by these rivers. Anthropogenic water pollution.

Tupolon is local in nature and appears only below the farmlands located in the floodplain, large settlements and industrial cities, as well as in oil and gas production areas. Tupolon, which has a high potential for self-purification, quickly restores its ecological state. Of all the tributaries, the largest contribution to the water pollution of the river. Tupolon is characterized by significant consumption of pollutants.

The Tupolon basin includes a significant number of diverse ecosystems of flowing and stagnant waters: streams of various sizes; mountain and steppe lakes of different sizes and salinity, small and large reservoirs. The seasonal dynamics of pigment characteristics, species composition and the level of development of phytoplankton of the upper reaches of the Tupolon indicates a high potential for biological self-purification of the river during the open water period, the dominant role of climatic and hydrodynamic factors in the formation and functioning phytoplankton. The trophic status of the Tupolon River section can be classified as mesotrophic-eutrophic. In the interannual aspect, it is quite stable, while in the seasonal aspect there are significant fluctuations

due to an increase in the productivity of the plankton community of the river during the growing season. The upper reaches of the Tupolon are also characterized by low numbers and biomass of zoobenthos, which is most likely due to natural causes: the spread of unproductive sandy soils in this section of the river. According to saprobiological indicators, the upper course of the river. Tupolon can be attributed to the oligo-beta-mesosaprobic zone with a slight increase in saprobity (up to the beta-mesosaprobic level). Over 20 years of observations, no significant changes in the composition, structure of the dominant complex and the abundance of hydrobionts of the upper reaches were noted, which indicates the stability of the state of bottom zoocenoses.

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